NON-PUBLIC?: N
ACCESSION #: 9107050020
LICENSEE EVENT REPORT (LER)

FACILITY NAME: SAN ONOFRE NUCLEAR GENERATING STATION, PAGE: 1 OF 06
UNIT 1

DOCKET NUMBER: 05000206

TITLE: MANUAL REACTOR TRIP FOLLOWING DROPPED CONTROL RODS DUE TO AN OPEN
CIRCUIT IN THE CONTROL ROD DRIVE CIRCUITRY
EVENT DATE: 05/28/91 LER #: 91-010-00 REPORT DATE: 06/27/91

OTHER FACILITIES INVOLVED: NONE DOCKET NO: 05000

OPERATING MODE: 1 POWER LEVEL: 91

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION:
50.73(a)(2)(i) & 50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:
NAME: R. W. Krieger, Station Manager TELEPHONE: (714) 368-6255

COMPONENT FAILURE DESCRIPTION:
CAUSE: X SYSTEM: AA COMPONENT: 75 MANUFACTURER: W120
REPORTABLE NPRDS: Y

SUPPLEMENTAL REPORT EXPECTED: NO

ABSTRACT:

At 2343 on 5/28/91, with Unit 1 in Mode 1 at 91% power, two of the 12 Control Bank 1 control rods (CRs) (H-6 and H-10) dropped into the core. Appropriate control room alarms were received and operators confirmed negative reactivity insertion per procedures. Operators properly responded (within 20 seconds) by manually tripping the reactor. At 2344, the auxiliary feedwater (AFW) system actuated on low steam generator (SG) water level which occurred due to expected SG water level shrinkage. At 0044 on 5/29/91, the reactor trip response procedure was exited with the plant stabilized in Mode 3.

The CRs dropped as a result of an open connection in the "half-voltage" resistor network associated with this rod subgroup. The open connection de-energized the moveable gripper coils associated with the affected rods, thus permitting them to drop into the core. The open connection was caused by a conductor/lug (jumper) connection failure at one termination point. Destructive physical analysis has revealed that the open connection resulted from long-term localized heating resulting in oxidation of the copper wire in the vicinity of the failure site. Continued heating led to arcing, melting, and eventual failure.

The failed jumper was replaced with in-kind parts. In addition, other jumper wires/lugs within the CR "half power" resistor bank were replaced in-kind. A continuity check and thermographic inspection were performed and no anomalous conditions were identified. Rod position indication and control rod drive operability tests were completed satisfactorily prior to startup.

END OF ABSTRACT

Plant: San Onofre Nuclear Generating Station
Unit: One
Reactor Vendor: Westinghouse
Event Date: 5/28/91
Time: 2343

A. CONDITIONS AT TIME OF THE EVENT:

Mode: 1, 91% Power Operation

B. BACKGROUND INFORMATION:

1. Rod Control System

The San Onofre Unit 1 rod control system AA! is divided into two Shutdown Banks and two Control Banks. Shutdown Bank 1 and Shutdown Bank 2 each contain eight control rod drive mechanisms (CRDM) DRIV!. Control Bank 1 contains 12 CRDMs. Control Bank 2 contains 17 CRDMs.

The rod control system controls the proper sequencing of DC power to the CRDMS. The CRDMs translate the electrical signal from the rod control system into a mechanical force to raise, lower, or hold the control rods (CRs) in a stationary position. Operation of each CRDM is controlled by sequencing the moveable

(hold) gripper coil CL!, the stationary gripper coil, and the lift coil, which are located at the reactor head. These three magnetic coils in each CRDM move two sets of latches which either lift, lower, or hold the grooved CR drive shaft dependent on the DC power application sequence.

The moveable gripper coil is the middle coil of the three operating coils. When the moveable gripper coil is energized, it causes the moveable gripper to latch the control rod drive shaft. Full power is supplied to the moveable gripper coil during CR movement. The CRs are also held in a stationary position by maintaining the moveable gripper coil energized. Half power is supplied to the moveable gripper coil during hold conditions to prevent excessive heat generation and eventual failure of the coil. This is accomplished through the use of a "half power" resistor bank (a non-safety related component), which limits the power use of the moveable gripper to 50% of maximum while the rods are stationary (refer to Figure 1). De-energization of the moveable gripper coil results in the associated CR being released into the core.

2. Shutdown Requirements

Technical Specification (TS) 3.5.3 Action B.2 requires that with one or more rods inoperable or misaligned from the step counter indicated position by more than 35 steps, the plant must be placed in HOT STANDBY within 6 hours. Abnormal Operating Instruction SO1-2.3-1, "Control Rod System Malfunctions," requires

the reactor to be tripped upon verification that two or more rods have dropped into the core.

Figure 1 omitted.

C. DESCRIPTION OF THE EVENT:

1. Event:

At 2343 on 5/28/91, with Unit 1 in Mode 1 at 91% power, two of the 12 Control Bank 1 CRs (H-6 and H-10) dropped into the core. Appropriate control room alarms were received and operators confirmed negative reactivity insertion per procedures. Operators properly responded (within 20 seconds) by manually tripping the reactor. At 2344, the auxiliary feedwater (AFW) system BA! actuated on low steam generator (SG) SG! water level which occurred due to expected SG water level shrinkage. At 0044 on 5/29/91, the reactor trip response procedure was exited with the plant stabilized in Mode 3.

2. Inoperable Structures, Systems or Components that Contributed to the Event:

None.

3. Sequence of Events:

TIME (DATE) ACTION

2343 (5/28) Two Control Bank CRs dropped into the core. Rod bottom lights were illuminated and alarms received. The reactor was manually tripped per procedure.

2344 (5/28) AFW system actuated.

0044 (5/29) The reactor trip response procedure was exited with Unit 1 stabilized in Mode 3.

4. Method of Discovery:

As described in Section C.1 above.

5. Personnel Actions and Analysis of Actions:

Operators responded properly to the dropped CRs by manually tripping the reactor in a timely manner. In addition, Operators responded properly to the reactor trip by verifying proper safety system responses and stabilizing plant conditions in accordance with procedures.

6. Safety System Responses:

The Reactor Protection System (RPS) JC! and AFW system performed as required by the design.

D. CAUSE OF THE EVENT:

1. Immediate Cause:

The reactor was manually tripped by Operations personnel upon identification that Control Bank CRs H-6 and H-10 had dropped into the core.

2. Intermediate Cause:

The CRs dropped as a result of an open connection in the "half-voltage" resistor network associated with this rod subgroup. The open connection de-energized the moveable gripper coils associated with the affected rods, thus permitting them to drop into the core. The open connection was caused by a conductor/lug (jumper) connection failure at one termination point (refer to Figure 1).

3. Root Cause:

Destructive physical analysis has revealed that the open connection resulted from long-term localized heating resulting in oxidation of

the copper wire multi-strand conductor in the vicinity of the failure site. A gradual increase in conductor resistance resulted in localized heat generation, leading to arcing,

melting and eventual failure.

The root cause investigation is continuing in order to finalize the details and factors that are relevant to the root cause failure. Any additional corrective actions other than those listed below that are derived from this investigation will be implemented as appropriate.

E. CORRECTIVE ACTIONS:

1. Corrective Actions Taken:

a. The failed conductor wire ("jumper") and lugs were replaced with in-kind parts.

b. Based on a visual inspection, other "jumper" wires/lugs within the CR "half power" resistor bank were also replaced in-kind (refer to Figure 1).

c. A continuity check was performed on all wires/lugs replaced or disturbed during the corrective maintenance.

d. Thermographic inspections were satisfactorily performed on the terminations following energization of the rod control cabinets.

e. Rod position indication and control rod drive operability tests were completed satisfactorily prior to startup.

2. Corrective Action Planned:

As described in D.3 above, SCE's root cause investigation is continuing. Appropriate corrective action(s) will be implemented. These corrective actions are expected to include periodic inspections of the Unit 1 "half power" resistor bank conductor wires/connections in order to identify incipient failures.

F. SAFETY SIGNIFICANCE OF THE EVENT:

The dropped rod analyses of record are applicable to the operating conditions which existed at the time of the rod drop event and bound this event. The double dropped rods H-6 and H-10 from Control Group 1 were specifically evaluated by one of these analyses and found to be non-limiting and acceptable. It was concluded that no safety limits were exceeded during this event. Therefore, this event was determined to have no safety significance.

G. ADDITIONAL INFORMATION:

1. Component Failure Information:.

12 AWG wire with Amphenol 10-12 lugs (NPRDS reportable against the CRDM CRDRVE!, Westinghouse W120! Model No. L-105)

2. Previous LERs for Similar Events:

LER 89-023 (Docket No. 50-206)

AT 1921 on 9/18/89, with Unit 1 in Mode 1 at 91% power, 4 of the 8 Shutdown Bank 2 CRs dropped into the core. Approximately 23 seconds later, the remaining 12 Shutdown Bank CRs (4 from Shutdown Bank 2 and 8 from Shutdown Bank 1) dropped into the core. A failed contactor coil was determined to be the cause. Subsequent corrective actions would not have prevented the wire failure that is reported in this LER (91-010).

ATTACHMENT 1 TO 9107050020 PAGE 1 OF 1

Southern California Edison Company

SAN ONOFRE NUCLEAR GENERATING STATION

P. O. BOX 128

SAN CLEMENTE, CALIFORNIA 92674-0128

R. W. KRIEGER TELEPHONE
STATION MANAGER (714) 368-6255
June 27, 1991

U. S. Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555

Subject: Docket No. 50-206
30-Day Report
Licensee Event Report No. 91-010

San Onofre Nuclear Generating Station, Unit 1

Pursuant to 10 CFR 50.73(d), this submittal provides the required 30-day written Licensee Event Report (LER) for an occurrence involving two dropped control rods. Neither the health nor the safety of plant personnel or the public was affected by this occurrence.

If you require any additional information, please so advise.

Sincerely,

Enclosure: LER No. 91-010

cc: C. W. Caldwell (USNRC Senior Resident Inspector, Units 1, 2 and 3)

J. B. Martin (Regional Administrator, USNRC Region V)

Institute of Nuclear Power Operations (INPO)

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